

STELLAR NEUTRON CAPTURE CROSS SECTIONS OF THE HF AND LU ISOTOPES

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The neutron capture cross sections of ^{176}Hf , ^{177}Hf , ^{178}Hf , ^{179}Hf , ^{180}Hf , and ^{175}Lu , ^{176}Lu have been measured in the energy range from 3 to 225 keV at the Karlsruhe 3.75 MV Van de Graaff accelerator. Neutrons were produced via the $^7\text{Li}(p, n)^7\text{Be}$ reaction by bombarding metallic Li targets with a pulsed proton beam. The Karlsruhe 4π Barium Fluoride Detector was used for registration of capture events. The cross sections were determined relative to the gold standard using highly enriched oxide samples. The respective ratios could be obtained with overall uncertainties between 0.9 and 1.8%, about a factor of five more accurate than previous data. Partial cross sections to ground and isomeric states could be experimentally identified for neutron capture in $^{176,177,178,179}\text{Hf}$ indicating a strong population of yet unknown isomeric states in ^{177}Hf and ^{180}Hf . This feature was further confirmed in extensive computer simulations with the GEANT code, using theoretically calculated capture cascades based on the known level schemes.

Maxwellian averaged neutron capture cross sections were calculated for thermal energies between $kT = 8$ keV and 100 keV. Severe differences up to 40% were found to the data of a recent evaluation based on the existing experimental results. The new data allow for a much more reliable analysis of the important branching in the s-process synthesis path at ^{176}Lu which can be interpreted as an s-process thermometer.